



Ultra-high-speed Optical Signal Processing using Silicon Photonics

Oxenløwe, Leif Katsuo; Ji, Hua; Jensen, Asger Sellerup; Hu, Hao; Mulvad, Hans Christian Hansen; Galili, Michael; Pu, Minhao; Frandsen, Lars Hagedorn; Yvind, Kresten

Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Oxenløwe, L. K., Ji, H., Jensen, A. S., Hu, H., Mulvad, H. C. H., Galili, M., Pu, M., Frandsen, L. H., & Yvind, K. (2013). *Ultra-high-speed Optical Signal Processing using Silicon Photonics*. Abstract from 34th Progress In Electromagnetics Research Symposium, Stockholm, Sweden.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Ultra-high-speed Optical Signal Processing Using Silicon Photonics

Leif Katsuo Oxenløwe, Hua Ji, Asger Sellerup Jensen,
Hao Hu, Hans Christian Hansen Mulvad, Michael Galili,
M. Pu, Lars Hagedorn Frandsen, and K. Yvind

DTU Fotonik, Department of Photonics Engineering, Technical University of Denmark
Ørstedes Plads, Building 343, Kgs. Lyngby 2800, Denmark

Abstract— In supercomputers, the optical inter-connects are getting closer and closer to the processing cores. Today, a single supercomputer system has as many optical links as the whole worldwide web together, and it is envisaged that future computing chips will contain multiple electronic processor cores with a photonic layer on top to interconnect them. For such systems, silicon is an attractive candidate enabling both electronic and photonic control. For some network scenarios, it may be beneficial to use optical on-chip packet switching, and for high data-density environments one may take advantage of the ultra-fast nonlinear response of silicon photonic waveguides. These chips offer ultra-broadband wavelength operation, ultra-high timing resolution and ultra-fast response, and when used appropriately offer energy-efficient switching.

In this presentation we review some all-optical functionalities based on silicon photonics. In particular we use nano-engineered silicon waveguides (*nanowires*) [1] enabling efficient phase-matched four-wave mixing (FWM), cross-phase modulation (XPM) or self-phase modulation (SPM) for ultra-high-speed optical signal processing of ultra-high bit rate serial data signals. We show that silicon can indeed be used to control Tbit/s serial data signals [2], perform 640 Gbit/s wavelength conversion [3] 640 Gbit/s serial-to-parallel conversion [4], 160 Gbit/s packet switching as well as all-optical regeneration [5]. We will also discuss the performance limitations of crystalline silicon and discuss emerging materials such as amorphous silicon [6].

ACKNOWLEDGMENT

European Research Council (ERC) project SOCRATES, Danish National Research Council (FTP) project NESTOR.

REFERENCES

1. Pu, M., et al., *Optics Communications*, Vol. 283, 3678, 2010.
2. Ji, H., et al., *OFC 2010*, postdeadline paper PDPC7, 2010.
3. Hu, H., et al., *OFC 2011*, postdeadline paper PDPA8, 2011.
4. Mulvad, H. C. H., et al., *ECOC'2011*, postdeadline paper, 2011.
5. Jensen, A. S., et al., *OECC'2013*, paper ThM1-2, 2013.
6. Kuyken, B., et al., *Opt. Lett.*, Vol. 36, No. 4, 552–554, 2011.